Materiel Test Procedure 9-2-235
General Equipment Test Activity

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U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

TANKS, PETROLEUM LIQUID STORAGE, FABRIC, COLLAPSIBLE

1. OBJECTIVE

The objective of this procedure is to determine the technial performance and safety characteristics of collapsible, fabric, liquid petroleum storage tanks, and their associated tools and equipment, as described in QMR's, SDR's, Technical Characteristics, and as indicated by the particular design and to determine the suitability of collapsible, fabric, liquid storage tanks for service tests.

2. BACKGROUND

A need exists for the storage of bulk petroleum fuels in self-supporting collapsible tanks and hasty storage reservoirs that will be capable of extremely rapid installation. A means of providing quickly erected, large-capacity, temporary fuel storage is required to replace comparable-size, rigid-type, cylindrical storage tanks now being used. These steel and aluminum bolted tanks which have been used in the past for bulk storage of fuels, require great outlays of manpower and time to install, and due to the fixed-roof concept, vapor losses are high. The Army has established a requirement for a storage device that will provide a needed facility for quickly installed storage units in various sizes between smaller capacities afforded by existing standard collapsible tanks and larger complexes, to include 1,250-, 2,500-, and 5,000-barrel tanks. The collapsible tanks should provide greatly reduced man-hours of construction effort, reduced logistical tonnages, greater resistance to damage by nuclear blasts, improved safety in operation, greater assurance in the maintenance of fuel quality during the storage phase, and less skilled manpower to install than rigid-type cylindrical tanks.

These collapsible tanks which are self-supporting, are fabricated from new lightweight, high-strength, flexible materials to ensure ease in handling, transportability, and installation, and are to be compatible with existing and proposed pipeline and hoseline systems. They are to provide points along trunk hoseline and pipeline systems. The tanks may also be used in temporary supply points and depots in the forward position of a theater. Initial storage for fixed supply installations and airfields are additional applications for these storage tanks, pending construction of more permanent facilities. A sample layout for collapsible tanks is shown in Appendix A.

3. REQUIRED EQUIPMENT

One or more of the following items and facilities may be required to obtain data during the various evaluations of the collapsible tank:

a. Fabric Samples (from developer)
b. Flowmeter, 350-g.p.m., 4-inch

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c. Flowmeter, 500- to 2000-g.p.m., 6-inch
d. Fuel Sampling Device
e. Fuel Supply Tank
f. Petroleum Analysis Facility
g. Photographic Facility
h. Physical Analysis Facility (tank fabric)
i. Platform Scales
j. Pressure Gages
k. Pumping Assembly, 350-g.p.m.
l. Pumping Assembly, Single-Stage, 6-inch
m. Pumping Assembly, Two-Stage, 6-inch
n. Glass Sampling Containers
o. Steel Measuring Tape
p. Suction Hose, 4-inch
q. Suction Hose, 6-inch
r. Test Fuels:

1) Automotive combat gasoline
2) Aviation gasoline
3) CITE fuel
4) Diesel fuel
5) JP-4 jet fuel

s. Electrostatic Voltmeter
t. Thermocouples
u. Thermometer, Mercury-in Glass
v. Lightweight Steel Tubing, 6- and 8-inch
w. Miscellaneous, Fittings, Valves, Couplers, Strainers, Adapters, etc.
x. Miscellaneous Firefighting Equipment such as foam generators, CO_2 fire extinguishers, and fire protection suits

4. REFERENCES

A. American Society for Testing and Materials - Standards (ASTM Standards) Parts 17 and 24
B. American Association of Textile Chemists and Colorists (AATCC)
C. Federal Specification VV-F-800 Diesel Fuel
D. Federal Specification CCC-T-191 Textile Test Methods
E. Federal Standard 601 Rubber: Sampling and Testing
F. Military Specification MIL-G-3056 Gasoline, Automotive Combat
G. Military Specification MIL-G-5572 Aviation Gasoline, Grades 80/87, 100/130, 115/145
H. Military Specification MIL-T-5624 Jet Fuel, Grades JP-4 and JP-5
I. Military Specification MIL-T-6396 Tank, Fuel, Oil, Water-Alcohol, Coolant Fluid, Aircraft Non-Self-Sealing, Removable, Internal
J. Military Specification MIL-F-8261 Fungus Resistance Tests, Aeronautical and Associated Materials, General Specifications for
K. Military Specification MIL-F-8901 Filter/Separators, Aviation and Motor Fuel, Ground and Shipboard Use, Performance Requirements and Test Procedures for

L. Military Specification MIL-F-46005 CITE Fuel
M. Military Standard MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes
N. National Fire Codes
O. Small Development Requirement Department of the Army Approved Small Development Requirement for Tanks, Collapsible, Self-Supporting, 1250, 2500, and 5000 Barrels
P. Technical Manual TM 5-343 Military Petroleum Pipeline Systems
Q. Technical Manual TM 5-350 Military Pipeline Systems
R. Technical Manual TM 10-1101 Petroleum-Handling Equipment and Operations
S. Technical Manual TM 10-1105 Inspecting and Testing Petroleum Products
T. Technical Manual TM 10-1107 Petroleum-Handling Operations for Aviation Fuel
U. USAMC Regulation 310-6 U.S. Army Materiel Command Quality Assurance Publications
V. USAMC Regulation 385-12 Verification of Safety of Materiel from Development through Testing and Supply Disposition
W. USAMC Regulation 385-224 AMC Safety Manual
X. USATECOM Regulation 310-6 Quality Assurance Publications, USATECOM Materiel Test Procedures, 700-700 Series
Y. USATECOM Regulation 385-6 Safety Release
Z. MTP 9-2-236 Tanks, Liquid Storage, Metal
AA. MTP 9-2-501 Operator Training and Familiarization
AB. MTP 9-2-503 Durability and Reliability
AC. MTP 10-2-500 Physical Characteristics

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following procedures:

a. Preliminary Operations - An evaluation of the time required to erect, and when appropriate, dismantle the test item, personnel and equipment involved, and the integrity of the test item's seams, gaskets, etc.

b. Technical Performance - An evaluation of the test item's capability to store fuel under various conditions without contaminating the fuel, and being contaminated by the fuel without being deteriorated by the fuel stored, and allowing for water drain-off.

c. Maintenance Evaluation - An evaluation of the adequacy of the test item's maintenance literature, tools, and repair kits.

d. Durability - An evaluation of the length of time the test item can be operated.

e. Safety - An evaluation of the safety of the test item.

f. Human Factors - An evaluation of the ease, simplicity, and effort required to install, operate, maintain, and, when applicable, dismantle and transport the test item so as to cause the least amount of fatigue, irritation, etc. within due military consideration.

5.2 LIMITATIONS

This materiel test procedure provides general test procedures to be used as a guide to current testing technology for collapsible, fabric, petroleum liquid storage tanks. These procedures relate primarily to 1250-, 2500-, and 5000-barrel tanks and should be adapted as necessary for tanks of other sizes and types. Metal liquid storage tank tests are described in MTP 9-2-236.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Operator Training and Familiarization

a. Ensure the presence of test personnel capable of assembling, installing, operating and maintaining the test item. The test personnel will receive briefings based on the operating instructions provided by the developer, on proper use and operation of the collapsible tanks and their accessory equipment using the criteria of MTP 9-2-501.

b. Personnel shall be trained in the use of the approved type of fire-fighting equipment and any other needed safety equipment. A local standing safety procedure will be prepared for each operation requiring safety precautions and all test personnel will familiarize themselves with these procedures.

6.1.2 Initial Inspections

Upon receipt of the test item at the test site, perform the following:

a. Visually inspect the test item packages and record the following:

1) Evidence of package deterioration or damage that may have occured during storage or transit
2) Identification markings, including:

a) Name of contractor
b) Number and date of the contract
c) Date of manufacture
d) Other markings pertaining to the test item

b. Photograph the test item(s) to identify the crates and their condition.

c. Weigh and measure the individually crated packages of the test item and its accessories and record the following:

1) For each shipping package:

a) Contents
b) Weight
c) Length, width, height

d) Cubage

2) For the entire test item:

a) Weight
b) Cubage

d. Unpack the test item, visually inspect it and record the following, when applicable:

1) Evidence of damage or deterioration
2) Evidence of incompleteness
3) Evidence of wear
4) Evidence of defects:

a) Manufacturing
b) Material
c) Workmanship

NOTE: Make use of photographs, narratives and diagrams to indicate the condition of the test item and its accessories.

5) Presence of instruction plates, when applicable, including:

a) Identification, name and serial number
b) Operating instructions
c) Maintenance instructions
d) Caution instructions

6.1.3 Physical Characteristics

Determine and record the following physical characteristics of the test item and its components:

a. Overall weight of the uncrated test item and its required accessories

b. For each individual test item component, if applicable:

1) Weight
2) Length, height, and width

NOTE: For the collapsible tank, itself, these dimensions are to be made with the tank empty and spread out on the ground. Dimensions of the filled tank will be measured during the test operation section 6.2.2.1.

3) Overall diameter
4) Positions and sizes of all openings and connection points

6.2 TEST CONDUCT

6.2.1 Preliminary Operations

6.2.1.1 Erection

Erect the test item, in accordance with its technical manual, using tools supplied and standard military equipment, in a test system layout using reference 4Q (TM 5-350) as a guide and record the following:

a. Time required to install the test item
b. Equipment required for installation
c. Number of personnel required for installation
d. Adequacy of installation instructions
e. Difficulties encountered during installation
f. Terrain features:

    1) Type soil
    2) Slope
    3) Amount of cut and fill required
    4) Amount of clearing and grubbing required

g. Test site slope
h. Difference in elevation between pump suction and tank inlet/outlet line
i. Distance between transfer pump and tank inlet/outlet

6.2.1.2 Initial Check-Out

Perform initial check-out operations on each type and size of collapsible tank, as directed, to aid in the training and familiarization of test personnel in the operation of the tanks, and to ensure that the tanks are in proper operational condition.

a. Fill the test item(s) with air or water and inspect it for the following:

    1) Leaks
    2) Defects
    3) Other malfunctions

b. Evaluate the test tank(s).
c. Repeat steps a and b for a minimum of two cycles.

6.2.1.3 Relocation of Test Item (When applicable)

Test tanks capable of being relocated shall be subject to the following:

a. Drain the test tank using normal drain operations.

b. Disconnect the test tank from the pumping system and perform the following:

1) Drain the tank and manifold to the maximum extent possible
2) Record the following:

a) Time required to disconnect the tank from the pumping system
b) Difficulties encountered in disconnecting
c) Number of personnel, and special equipment required to disconnect

c. Dismantle the test item, load the test item components into a transport vehicle (in the uncrated state), move it to a new test site, re-erect the test item and record the following:

1) Time required to:

a) Dismantle the test item
b) Load the test item components onto the transport vehicle
c) Unload and re-erect the test item

2) Difficulties encountered, if any:

a) Dismantling the test item
b) Loading the test item components onto the transport vehicle
c) Moving the test item to its new location
d) Unloading and re-erecting the test item

3) Number of personnel, and special equipment required:

a) To dismantle the test item
b) Transport the test item
c) Unload and re-erect the test item

4) Adequacy of dismantling instructions
5) New site terrain features:

a) Type soil
b) Slope (before preparation)
c) Amount of cut and fill required
d) Amount of clearing and grubbing required
e) Slope (after preparation)

6.2.2 Technical Performance

The technical performance of the test tank shall be evaluated under

the following criteria:

a. The test fuel specified in the test directive shall be used during all test operations.

b. The test tank shall be subject to a minimum of 40 test cycles (filling and evacuating) as follows:

1) Five cycles will be conducted using a 350 gpm pumping unit with a 4-inch flexible hoseline.
2) Fifteen cycles will be conducted using a 6-inch, single stage pumping unit with a 6-inch or 8-inch coupled pipeline.
3) Ten cycles will be conducted using a 6-inch two-stage pumping unit with a 6- or 8-inch coupled pipeline.
4) Ten cycles will be conducted using two 6-inch pumping units manifolded in series or parallel.

c. Two test cycles will be conducted each week with the fuel remaining stored in the test tank during cycles.

6.2.2.1 Filling and Emptying Operation

a. Fill the test item with fuel from the test supply tank(s) until it is approximately 25-percent full and record the volume of fuel in the test item as indicated by:

1) Flowmeter
2) Gaging system provided by the manufacturer, or
3) Gage table devised by the test engineer using the criteria of reference 4R (TM-10-1101)

b. Continue to fill the tank and record the volume of fuel, as indicated in step a, when it is at 50-, 75-, and 100-percent rated capacity as indicated by the flowmeter.

c. Record the following during the fill operation:

1) Pumping unit and hoseline/pipeline used
2) Actual time required to fill the tank
3) Pump rpm and suction and discharge gauge readings
4) Rate of fuel flow (flowmeter readings)
5) Ambient temperature
6) Fuel temperature
7) Relative humidity
8) Date of operation in month(s) and day(s)
9) Difference in elevation between pump junction and tank inlet/outlet
10) Pipe distance from transfer pump to tank inlet/outlet

d. Perform the following when the tank is at 100-percent of rated capacity:

1) Visually examine the test item and record leaks and seepage.
2) Measure and record the length, width or overall diameter,

and height of the tank.

e. Remove fuel from the test tank until the following approximate volume is left in the test tank and record the meter readings as indicated in step a:

1) 75-percent
2) 50-percent
3) 25-percent

f. Continue to empty the test tank until the pump is no longer capable of removing fuel and record the following:

1) Actual time required to empty the tank
2) Pump rpm, and suction and discharge guage readings
3) Rate of fuel flow
4) Volume of fuel left in the tank when pump loses suction
5) Ambient temperature
6) Fuel temperature
7) Volume of fuel that cannot be removed from the tank by reducing the pump rpm

g. At the completion of the emptying portion of the cycle, visually inspect the test tank and record the following:

1) Evidence of corrosive action, on metal parts, due to the test fuel
2) Deterioration of gaskets, sealants and tank fabric
3) Condition of the test tank seams, folds, and creases
4) Evidence of leaks

h. Repeat steps a through g, for a minimum of 40 cycles as directed in the test plan, or by the test director, following the restrictions of steps b and c of paragraph 6.2.2.

i. Once each month, at the completion of an emptying operation, determine the following by visual inspection:

1) Condition of the outside of the tank bottom (partially fold back a corner of the tank over the tank)
2) Condition of the tank interior (observations to be made through the flanged openings)

j. During the conduct of steps a through h, determine the amount of fuel innage for each inch increase or decrease in fuel height as indicated by a fuel flowmeter.

k. A monthly all level fuel sample will be taken for the following laboratory analysis:

1) Total aromatic content
2) Read vapor pressure
3) A.P.I. Gravity
4) Total Solids (Millipore)
5) Total water (Karl Fischer)

6) Existant germs

6.2.2.2 Pressure Surge

During a minimum of two filling and emptying cycles, when using the 350 gpm pumping unit, determine the effects of pressure surge on the tank as follows:

6.2.2.2.1 Pump Induced Surge Tests - Perform the following:

a. During the filling portion of the cycle, with a normal flow rate, perform the following when the tank is approximately 25-percent full:

1) Stop the pump to create a pressure surge and record:

a) Maximum pressure surge
b) Detrimental effects, if any
c) Forcing out of fuel through the tank venting device

2) Start the pump to create a pressure surge and record:

a) The maximum pressure surge
b) Detrimental effects, if any
c) Forcing out of fuel through the tank venting dev.ce

b. Repeat step a, increasing the flow rate in 5-percent increments, until the flow rate is 125-percent of the normal flow rate.

c. Repeat steps a and b with the tank approximately 50-, 75-, and 100-percent full.

d. Repeat steps a and b, while emptying the tank, at approximately the 75-, 50-, and 25-percent filled points.

6.2.2.2.2 Valve Induced Surge - Perform the following:

a. During the filling portion of the cycle, with a normal flow rate, and the tank approximately 25-percent full, create a pressure surge, by quickly opening and closing the tank valve and record:

1) The maximum pressure surge
2) Any detrimental effects
3) Forcing out of fuel through the tank venting device

b. Repeat step a, increasing the flow rate in 5-percent increments, until the flow rate is 125-percent the normal flow rate.

c. Repeat steps a and b with the tank approximately 50-, 75-, and 100-percent full.

d. Repeat steps a and b, while emptying the tank, at approximately the 75-, 50-, and 25-percent filled points.

6.2.2.2.3 Additional Pressure Surge Tests - Should the test tank successfully resist the effects of paragraphs 6.2.2.2.1 and 6.2.2.2.2, perform the following:

a. Repeat paragraphs 6.2.2.2.1 and 6.2.2.2.2 using a standard military 6-inch, single stage pumping unit with a 6-inch pipeline.

b. Repeat paragraphs 6.2.2.2.1 and 6.2.2.2.2 using two 6-inch

pumping units manifolded to pump in parallel and series.

6.2.2.3 Water-Drain System Test

During the tenth filling cycle, perform the following:

a. Inject water into the influent fuel stream at the rate of 0.5-percent of the fuel flow rate and record the amount of water injected.

b. Allow the tank to remain static for a minimum of 24 hours to permit the water to settle and perform the following:

1) Determine and record the location within the tank at which the water tends to concentrate.

NOTE: The location is determined by taking samples from the bottom.

2) Determine and record if the water concentration location can adversely affect the operation of the tank.

c. Operate the water-drain system and record the amount of water which is removed from the tank. Compare this valve with the amount of water injected into the tank to determine the adequacy of the water drain.

6.2.2.4 Static Fuel Storage Tests

6.2.2.4.1 Test Tank Tests - Determine the long range effects of fuel storage as follows:

a. Fill a test tank to capacity with test fuel.

b. Obtain a five-gallon sample of the test fuel and store it in a glass container, protected from direct solar radiation, and adjacent to the test item.

c. Perform an initial analysis on the test fuel, using the applicable sections of MTP 10-2-500 and record the following:

1) Water content
2) Solids content
3) A.P.I. gravity
4) Aromatic content
5) Gum content
6) Reid vapor pressure
7) Distillation

d. At monthly intervals, for a minimum of six months, perform the following:

1) Obtain all level fuel samples from the test tank.
2) Analyze the samples of step d.1 and a sample of the fuel stored in step b as described in step c.

NOTE: The Reid vapor pressure test is conducted to determine vapor pressure degradation of the stowed fuel.

3) Obtain a sample of the water at the bottom of the test tank and perform the following:

a) Analyze the water and determine if, and to what extent, microbiological organisms tend to grow.
b) Determine if this water results in a chemical reaction with the tank material causing deterioration.

4) Gage the test tank and record the monthly fuel volume lost by evaporation or diffusion.
5) Record any visual deterioration of the tank fabric, seams, gaskets, etc.

e. At the completion of the static storage test, decant the test tank, visually examine the test tank, and record the following:

1) Presence of corrosion of the tank interior metal parts
2) Condition of the tank fabric, seams, gaskets, etc.
3) Condition of the tank bottom
4) Condition of the tank interior

6.2.2.4.2 Fabric/Fuel Effects Tests - Determine the effect of the various fuels on the test tank fabric, and the effect of the test tank fabric on the various fuels as follows:

a. At the beginning of the engineering tests, obtain samples of the test item fabric and subject a minimum of three samples, unless otherwise specified in the developer's purchase description for the test tank, to each of the following tests:

1) As described in reference 4D (Fed. Spec. CCC-T-191):

a) Breaking strength
b) Tear strength
c) Puncture resistance
d) Abrasion resistance
e) Coating to fabric adhesion

2) As described in reference 4E (Fed.-Std. 601):

a) Seam strength - shear
b) Seam strength - peel

3) As described in reference 4A (ASTM Standards Manual):

a) Flammability: D1230
b) Thermal Transmittance: D1518
c) Elongation: D1682

4) Diffusion as described in reference 4I (MIL-T-6396)
5) Static charge tests as described in reference 4B (AATCC)
6) Fungus resistance tests as described in reference 4J (MIL-F-8261)

b. Obtain 3 five-gallon glass containers for each of the following fuels, from the same source, and subject each fuel to the analysis of paragraph 6.2.2.4.1.c:

1) Automotive combat gasoline (MIL-G-3056 B)
2) Diesel fuel (Fed. Spec. VV-F-800)
3) Aviation gasoline (MIL-G-5572)
4) JP-4 jet fuel (MIL-J-5624F)
5) CITE fuel (MIL-F-46005)

c. Place the fuel samples as follows:

1) One sample of each fuel type in the test sites analysis laboratory
2) One sample of each fuel type in the field adjacent to the test tank
3) One sample of each fuel type in the field, adjacent to the test item, with a minimum of six fabric samples in each fuel container, each sample large enough to be subject to all the test procedures of step a.

NOTE: 1. If this is not possible, use as many additional five-gallon containers as required to ensure sufficient fabric samples.
2. Only the inside portion or the fabric sample should be exposed to the test fuel. The outside of the sample should be exposed to the surrounding environment.

d. At monthly intervals, for a minimum of six months, perform the following:

1) Obtain fuel samples from each fuel sample (laboratory, field, and field with fabric) and subject each sample to a laboratory analysis,to determine the effect of the different environments and the fabric on the fuel, as described in paragraph 6.2.2.4.1.c.
2) Obtain a sample of fabric from each type of fuel and subject it to the analysis of step a.

6.2.2.4.3 Tank Fabric Final Checks - At the completion of paragraph 6.2.2.4.1, perform the following:

Subject failed samples selected at random from the test items subjected to the analysis listed in paragraph 6.2.2.4.2.a, for comparison with original unexposed tank failure analysis.

6.2.2.5 Manifold Adaptability

Determine and record the following:

a. The manifold's adaptability to various size welded or coupled pipelines (6-,8-, and 12 inch).

b. What special fittings, if any, are needed for connection to standard military hoselines and coupled pipelines.

c. If the manifold assembly (suction hose and steel tubing) is of sufficient length to permit joining of additional tanks to the system giving consideration to dispersion, requirements for earth firewalls, volatility of products, and quantity-distance factors in determining the fire safety of the tank system.

6.2.3 Maintenance Evaluation

Conduct the following procedures in order to evaluate the adequacy of maintenance literature, tools, and repair kit, if furnished:

a. Record the action taken in all scheduled and nonscheduled maintenance.

b. Whenever a failure occurs, record the following:

1) Time required to diagnose the cause of failure and make repairs
2) Deficiencies in the repair kit, if any
3) Perform the filling and emptying operations of paragraph 6.2.2.1 to ensure the validity of the repair

c. In the event a puncture or repairable failure does not occur during normal operation:

1) Deliberately puncture the tank
2) Make the necessary repairs using the repair kit
3) Repeat the procedures of steps b.2 and b.3

d. Determine and record the bursting strength of patching material supplied with the repair kit, as described by the Mullen Burst Test (D 1117) of reference 4A to ensure that subject patching material is at least equal in strength to the outlined tank fabric.

6.2.4 Durability

Throughout the conduct of paragraph 6.2.2, determine the durability of the test item, and its components, as described in the applicable sections of MTP 9-2-503.

6.2.5 Safety

Evaluate the safety characteristics of the test item based on a safety statement issued by the developing agency, as follows:

a. Exercise normal safety precautions for petroleum handling as specified in TM 10-1101, TM10-114 and API Bulletin 2016, at all times.

b. Using an ohmmeter, measure and record the resistance between various parts of the test item and the ground to determine the adequacy of electrical grounding and bonding devices furnished with the test item.

c. Measure and record the electrostatic buildup in the test tank and manifold during the pumping operation with an electrostatic voltmeter, during cold weather operations if possible.

d. The safe operating pressure limits will be determined based on visual observations of the test item during pumping operations at various operating pressures.

e. Determine fire safety factors such as:

1) Evaluation of developer's safety statement
2) Tank dispersion
3) Firewall requirements
4) Volatility of products
5) Quantity distance factor
6) Firefighting equipment requirements imposed on the system

f. Throughout the test period, test personnel will observe and record any condition that might present a safety hazard, the cause of the hazard and steps taken to alleviate the hazard.

6.2.6 Human Factors

The human factors evaluation is made by observing the effectiveness of the man-item relationship during operational use and to assess the ease, simplicity, and effort of installing, operating, and maintaining the test item during normal use. Throughout the test, observations will be made and recorded in the operational log book regarding the following:

a. Identifications of no-step and other areas that could lead to injury of personnel

b. Environmental conditions affecting human performance or equipment performance during installation and operation of the test item

c. Information needed for operator decisions

d. Simplification of maintenance

e. Fatiguing operations

f. Tank cleaning accessibility

g. Inaccessibility of operator's controls

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

a. Record the following, as applicable:

1) Evidence of packaging damage or deterioration
2) Identification markings:

a) Name of contractor
b) Number and date of contract
c) Date of manufacturer
d) Other markings pertaining to the test item

3) For each shipping container:

a) Contents
b) Weight in pounds
c) Length, width and height in feet and inches
d) Cubage in $feet^3$

4) For the entire crated test item:

a) Weight in pounds
b) Cubage in $feet^3$

5) For the test item:

a) Evidence of damage or deterioration
b) Evidence of incompleteness
c) Evidence of wear
d) Evidence of defects, as applicable:

1) Manufacturing
2) Material
3) Workmanship

e) Presence of instruction plates, when applicable:

(1) Identification
(2) Operating
(3) Maintenance
(4) Caution

b. Retain all photographs taken.

6.3.1.2 Physical Characteristics

Record the following:

a. Overall weight of the test item in pounds
b. For each test item component, as applicable:

1) Component nomenclature
2) Weight in pounds
3) Length in feet and inches
4) Height and weight in feet and inches
5) Overall diameter in feet and inches
6) Diameter of all openings and connections in inches
7) Position of all openings and connections

6.3.2 Test Conduct

6.3.2.1 Preliminary Operations

6.3.2.1.1 Erection -

Record the following:

a. For installation procedures:

1) Time required in hours
2) Equipment required
3) Number of personnel required
4) Time of erection in month and day(s)
5) Adequacy of instructions

b. For installation system:

1) Type of soil (clay, sandy, rocky, etc.)
2) Slope of terrain in percent
3) Amount of cut and fill in cubic feet
4) Area of grubbing and clearing in square feet
5) Slope of test site in percent
6) Elevation between pump suction and tank inlet/outlet in feet
7) Distance between pump and tank inlet/outlet in feet

6.3.2.1.2 Initial Check-Out

Record the following for each cycle:

a. Cycle number (1, 2)
b. Leaks, if applicable
c. Defects, if applicable
d. Other malfunctions, if applicable

6.3.2.1.3 Relocation of Test Item (when applicable) -

Record the following:

a. Time, in hours, required to:

1) Disconnect the tank from the pumping system
2) Dismantle the test item
3) Load the test item components onto the transport vehicle
4) Unload the test item
5) Re-erect the test item

b. Difficulties encountered:

1) Dismantling the tank from the pumping system
2) Dismantling the test item
3) Loading the test item components onto the transport vehicle
4) Moving the test item to its new location
5) Unloading the test item
6) Re-erecting the test item

c. Number of personnel required to:

1) Disconnect the tank from the pumping system
2) Dismantle the test item
3) Transport the test item
4) Unload the test item
5) Re-erect the test item

d. Special equipment required to:

1) Disconnect the tank from the pumping system
2) Dismantle the test item
3) Transport the test item
4) Unload the test item
5) Re-erect the test item

e. Adequacy of dismantling instructions
f. New site terrain features:

1) Type soil (clay, sandy, rocky, etc.)
2) Terrain slope (before preparation) in percent
3) Amount of cut and fill in cubic feet
4) Amount of clearing and grubbing in square feet
5) Test site slope (after preparation) in percent

6.3.2.2 Technical Performance

NOTE: Appendices B and C are examples of Test Data Sheets.

6.3.2.2.1 Filling and Emptying Operations

Record the following for all filling and emptying operations.

a. Test fuel used (combat gasoline, CITE, etc.)

b. For type of pumping system:

1) Number of pumps
2) Pump capacity in gallons per minute

c. Type of manifold system (series or parallel)
d. For pipeline/hoseline:

1) Size of pipe/hose in inches
2) Material (flexible, coupled, etc.)

e. Difference in elevation between pump suction and tank inlet/outlet in feet
f. Pipe distance from transfer pump to tank inlet/outlet in feet
g. Test cycle (1, 5, 10, etc.)
h. Special activity performed during cycle (pressure surge, water drain-off, etc.)
i. When filling tank:

1) Time (pumping) required to fill tank in hours and/or minutes
2) Pump rpm
3) Pump suction pressure in inches of mercury
4) Pump discharge pressure in psi
5) Rate of fuel flow in gallons per minute
6) Ambient temperature in °F
7) Fuel temperature in °F
8) Relative humidity in percent
9) Date of operation in month(s) and day(s)
10) For gaging information:

a) Metered volume in gallons
b) Gaging system volume indication in gallons

11) For tank at 100-percent capacity:

a) Presence of leaks, seepage, etc.
b) Height of tank in feet
c) Length and width of tank in feet or
d) Overall diameter of tank in feet

j. When emptying tank:

1) Time (pumping) required to empty tank in hours and/or minutes
2) Pump rpm
3) Pump suction pressure in inches of mercury
4) Pump discharge pressure in psi
5) Rate of fuel flow in gallons per minute
6) Volume of fuel left when pump loses suction
7) Volume of fuel left after reducing pump rpm
8) Ambient temperature in °F
9) Fuel temperature in °F
10) Relative humidity in percent

11) Date of operation in month(s) and day(s)
12) For gaging information:

a) Metered volume in gallons
b) Gaging system volume indication in gallons

k. At the completion of each cycle:

1) Evidence of corrosive action due to the test fuel
2) Deterioration of gaskets, sealants and tank fabric
3) Condition of test tank seams, folds, and creases
4) Evidence of leaks

l. Each month:

1) Month number (1, 3, 5 etc.)
2) Condition of outside of tank bottom
3) Condition of tank interior
4) For laboratory analysis:

a) Sample location (tank top, bottom, etc.)
b) Total aromatic content
c) Reid vapor pressure
d) A.P.I. Gravity
e) Total solids (Millipore)
f) Total water (Karl Fischer)
g) Existant germs

m. Test tank innage/outage data

6.3.2.2.2 Pressure Surge -

Record the following:

a. Test cycle number (5, 10, 15, etc)
b. Pump/manifold/line used (350 gpm pumping unit; 6-inch single stage pump, etc)
c. For each pump induced surge:

1) Pump position (starting, stopping)
2) Operation (filling, emptying)
3) Rate of fuel flow in percent of normal (100-, 105-, 110-, etc.)
4) Approximate volume of fuel in tank in percent (25-, 50-, etc.)
5) Maximum pressure in psi
6) Detrimental effects, if any
7) Fuel forced through tank venting device

d. For each valve induced surge:

1) Operation (filling, emptying)
2) Rate of fuel flow in percent of normal (100-,105-,110-, etc.)
3) Approximate volume of fuel in tank in percent (25-, 50-, etc.)
4) Maximum pressure in psi

5) Detrimental effects, if any
6) Fuel forced through tank venting device

6.3.2.2.3 Water-Drain System Test -

Record the following:

a. Fuel rate of flow in gallons per minute
b. Water injection rate in gallons per minute
c. Total volume of water injected in gallons
d. Settling time in hours
e. Location of water concentration in tank
f. Volume of water drawn off in gallons
g. Volume of water remaining in tank in gallons
h. Effect of water concentration on tank efficiency

6.3.2.2.4 Static Fuel Storage Tests -

Record the following:

a. For test tank tests:

1) Fuel information at the start of the test:

a) Water content
b) Solids content
c) A.P.I. gravity
d) Gum content
e) Reid vapor pressure
f) Distillation

2) Each month during the test period:

a) Month of test (1st, 2nd, etc.)
b) Date in day and month
c) Sample location (tank bottom, middle, top; glass stored)
d) For fuel analysis:

(1) Water content
(2) Solids content
(3) A.P.I. gravity
(4) Aromatic content
(5) Gum content
(6) Reid vapor pressure
(7) Distillation

e) Analysis of test tank bottom water
f) Volume of test fuel lost by evaporation and/or diffusion in gallons
g) Deterioration of the test tank fabric, seams, gaskets, etc.

3) At the completion of the test:

a) Presence of corrosion of the tank interior metal parts
b) Condition of the tank fabric, seams, gaskets, etc.
c) Condition of tank bottom
d) Condition of the tank interior

b. For Fabric/Fuel Effects tests:

1) Fuel information at the start of the test:

a) Test fuel (combat gasoline, CITE, etc.)
b) Water content
c) Solids content
d) A.P.I. gravity
e) Aromatic content
f) Gum content
g) Reid vapor pressure
h) Distillation

2) Fabric information at the start of the test:

a) Data collected as described in reference 4D (Fed. Spec. CCC-T-191) for:

(1) Breaking strength
(2) Tear strength
(3) Puncture resistance
(4) Abrasion resistance
(5) Coating to fabric adhesion

b) Data collected as described in reference 4E (Fed. Std. 601) for:

(1) Seam strength-shear
(2) Seam strength-peel

c) Data collected as described in reference 4A (ASTM Standards Manual):

(1) Flammability (D 1230)
(2) Thermal transmittance (D 1518)
(3) Elongation (D 1682)

d. Diffusion data collected as described in reference 4I (MIL-T-6396)
e. Static charge data collected as described in reference 4B (AATCC)
f. Fungus resistance data collected as described in reference 4J(MIL-F-8261)

3) Each month during the test period:

a) Month of test(1st, 2nd, etc.)
b) Date in day and month
c) Test fuel (combat gasoline, CITE, etc.)
d) Method of storage (laboratory, field, field and fabric)
e) For fuel analysis:

(1) Water content
(2) Solids content
(3) A.P.I. gravity
(4) Aromatic content
(5) Gum content
(6) Reid vapor pressure
(7) Distillation

f) For fabric analysis (for field and fabric only):

(1) Data collected as described in reference 4D (Fed. Spec. CCC-T-191) for:

(a) Breaking strength
(b) Tear strength
(c) Puncture resistance
(d) Abrasion resistance
(e) Coating of fabric adhesion

(2) Data collected as described in reference 4E (Fed. Std. 601) for:

(a) Seam strength - shear
(b) Seam strength - peel

(3) Data collected as described in reference 4A (ASTM standards manual) for:

(a) Flammability (D 1230)
(b) Thermal transmittance (D 1518)
(c) Elongation (D 1682)

(4) Diffusion data collected as described in reference 4I (MIL-T-6396)
(5) Static charge data collected as described in reference 4B (AATCC)
(6) Fungus resistance data collected as described in reference 4J (MIL-F-8261)

c. For tank fabric final checks:

Record the following:

1) For fabric analysis:

a) Place fabric came from (seam, side, etc.)
b) Data collected as described in reference 4D (Fed. Spec. CCC-T-191) for:

(1) Breaking strength
(2) Tear strength
(3) Puncture resistance
(4) Abrasion resistance
(5) Coating of fabric adhesion

c) Data collected as described in reference 4E (Fed. Std. 601) for:

(1) Seam strength - shear
(2) Seam strength - peel

d) Data collected as described in reference 4A (ASTM standards manual) for:

(1) Flammibility (D 1230)
(2) Thermal transmission (D 1518)
(3) Elongation (D 1682)

e) Diffusion data collected as described in reference 4I (MIL-T-6396)
f) Static charge data collected as described in reference 4B (AATCC)
g) Fungus data collected as described in reference 4J (MIL-F-8261)

6.3.2.2.5 Manifold Adaptability -

Record the following:

a. Adaptability to various welded or coupled pipelines
b. Special fittings required for attachments to standard hoselines and coupled pipelines
c. Sufficiency of length to permit joining of additional tanks to the system

6.3.2.3 Maintenance Evaluation

Record the following:

a. Scheduled and nonscheduled maintenance performed
b. Time required to diagnose cause of failures and to make repairs
c. Deficiencies in the repair equipment and suggested corrective action
d. Location of deliberate puncture
e. For filling and emptying operation:

1) Fuel used (combat gasoline, CITE)

2) For pumping system:

a) Number of pumps
b) Pump capacity in gallons per minute

3) Type of manifold system (series, parallel)
4) For pipeline/hoseline:

a) Size of pipe/hose in inches
b) Material (flexible, coupled, etc.)

5) For filling/emptying operation:

a) Operation (filling, emptying)
b) Time (pumping) required to complete operation
c) Pump rpm
d) Pump suction pressure in inches of mercury
e) Pump discharge pressure in psi
f) Rate of fuel flow in gallons per minute
g) Ambient temperature in °F
h) Fuel temperature in °F
i) Relative humidity in percent
j) For gaging information:

(1) Metered volume indication at 25-, 50-, 75- and 100-percent of capacity in gallons
(2) Gaging system volume indication in gallons

k) For emptying operation only:

(1) Amount of fuel remaining in the tank, when pump loses suction, in gallons
(2) Amount of fuel that cannot be removed from tank, by reduction of pump rpm, in gallons

6) Evidence of:

a) Corrosive action on metal parts
b) Deterioration of gaskets, sealants, and tank fabric
c) Condition of tank seams, folds, creases
d) Leaks

f. Bursting strength data collected and recorded as described in reference 4A (Mullen Burst Test-D1117 of ASTM standards manual) for:

1) Test tank fabric
2) Repair kit patching material

6.3.2.4 Durability

Data shall be collected and recorded as described in the applicable

sections of MTP 9-2-503.

6.3.2.5 Safety

Record the following:

a. For resistance to ground test:

1) Component being tested
2) Resistance in ohms

b. For electrostatic buildup during all testing:

1) On the tank in volts
2) In the manifold system in volts

c. Safe tank operating pressure in psi
d. Evaluation of developer's safety statement
e. For fire safety factors:

1) Tank dispersion in feet
2) Firewall requirements
3) Volatility of fuels
4) Quantity distance factor
5) Firefighting equipment requirements imposed on the system

f. Safety hazard observed and corrective action taken

6.3.2.6 Human Factors

Record the following:

a. Identifications of no-step and other areas that could lead to injury of personnel
b. Environmental conditions affecting human performance
c. Information required for operator decisions or safety
d. Procedures for maintenance simplification
e. Fatiguing operations
f. Accessibility to the interior of the tank for cleaning and repair
g. Inaccessibility of operator's controls

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

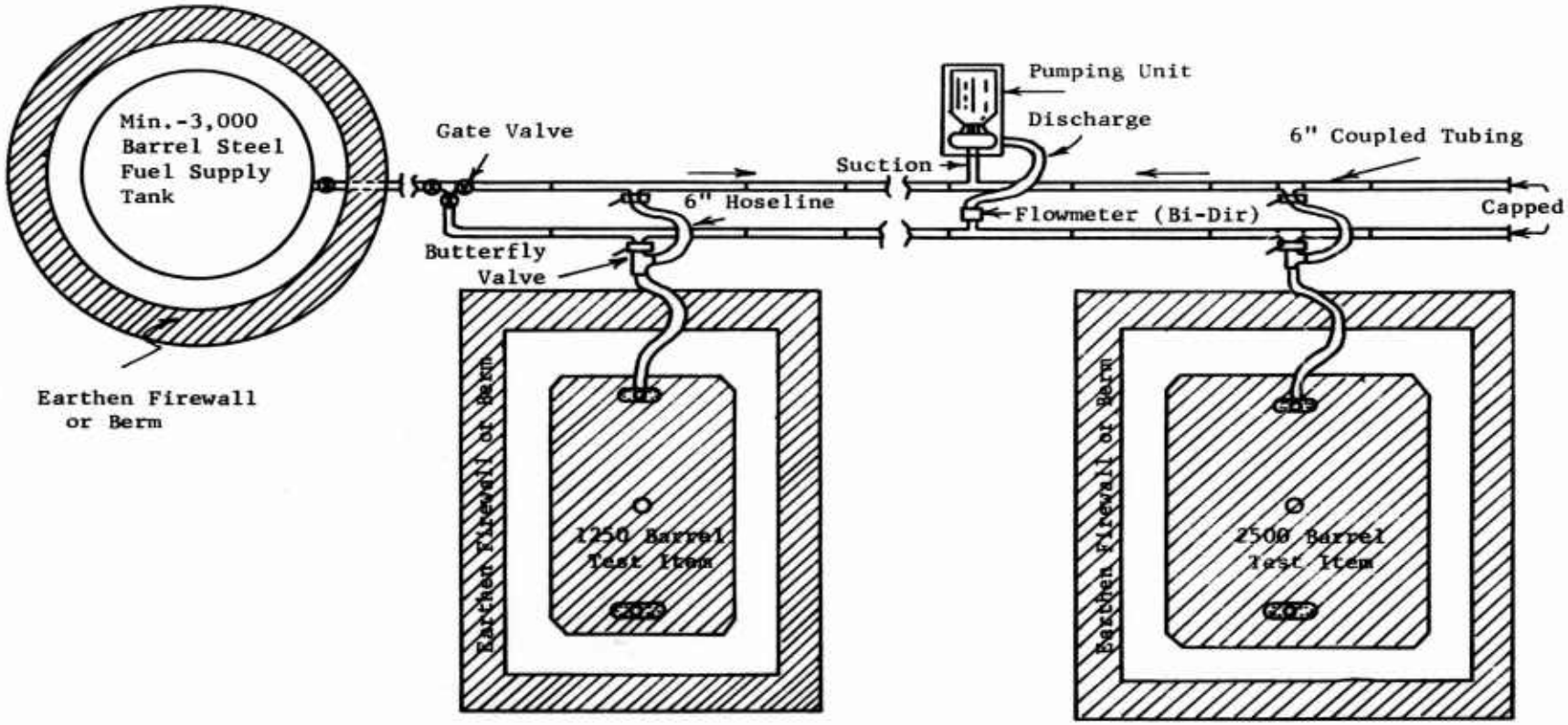
Data obtained during the conduct of the t will be summarized using charts and graphs as appropriate. The test data will be evaluated by determining the extent to which it meets the requirements of the technical characteristics, safety factors, and detail specifications for the collapsible tank.

6.4.2 Strapping Table

Prepare a strapping table using the innage and outage data obtained as directed in paragraph 6.2.2.1.j and recorded in paragraph 6.3.2.2.1.m.

APPENDIX A

TYPICAL TEST SYSTEM LAYOUT FOR COLLAPSIBLE STORAGE TANKS



APPENDIX B

TEST RUN DATA

Test Fuel _____ Test Item _____ Personnel _____

Date _____ Weather _____ Time _____

TEST CYCLE NO.	TIME HRS.			PRESSURE (PSI)			METER READING (GPM)		TEST ITEMS DIMENSIONS (FILLED) (FT)			APPROX. VOL. FUEL REMAINING IN TANK (GALLONS)	GAUGED TANK VOLUME (GALLONS)
	START	STOP	TOTAL	PUMP DIS.	PUMP SUC.	TEST ITEM	IN	OUT	L	W	H		

TEST CYCLE NO.	TEMPERATURE (°F)		REMARKS
	AMB.	FUEL	

NOTES:

APPENDIX C

FUEL SAMPLE ANALYSIS

Test Item _____ Test Fuel _____ Time _____

Date _____ Weather _____ Personnel _____

TEST CYCLE NO.	SAMPLE NO.	TIME	TEMPERATURE (°F)		VOL. FUEL IN TANK	SAMPLE LOCATION	SAMPLE ANALYSIS TEST RESULTS			OTHER
			FUEL	AMBIENT			WATER (PPM)	GUM CONTENT	SOLIDS (MG/L)	

NOTES: